CAUTION ⚠ Insulation on electrical wiring deteriorates with age. Check for brittle or deteriorated insulation on power cord and all other electrical wiring.

7. For the model 3500, place the bassinet on a level surface. Check that all four casters are in firm contact with the floor and that the bassinet moves freely.
8. For the model 3500, lock the two front casters and check that the bassinet is held in place.
9. Examine the unit for objects placed on top of the heater assembly.

WARNINGS

⚠ **Do not place any accessories or other objects directly over the bed surface. This may block radiant energy and lead to cooling of the infant.**

⚠ **Do not place items on top of the heater assembly. Items placed on top of the heater assembly can fall and injure the patient, and prevent adequate ventilation of the heater assembly.**

B. Heater Rotation

Rotate the heater to the side and then back to the normal position. Check for smooth rotation.

C. Mechanical Checks

1. Check the operation of the bed sides. The bed sides should operate smoothly and lock securely in place.

   For the model 3500:

   a. Unlock the ends by sliding the latch buttons outward to expose the red dots.

   b. Check that the bed sides lower and raise smoothly.

   c. Check that the ends lock by sliding the latch buttons to cover the red dots.

WARNING

⚠ **Regularly inspect the bed side panel latching mechanism, and the bedside locking mechanism on the model 3500, to ensure proper operation.**

2. Check the operation of the tilt mechanism. Verify that the bed platform operates smoothly and locks in normal, Trendelenburg and Fowler positions.
3. If the drawer package is installed, check that the drawers open and close freely.

   On units with the rotating drawer package, push the corner and insure the drawer package moves freely left and right 90° and then seats in the detent position.

WARNING ⚠ **Overloading the drawers can affect the stability of the unit. Limit the load to 10 lbs. (4.6 kg) per drawer, 20 lbs. (9 kg) per deep drawer.**

4. For the model 3500 bassinet, remove the keys from the top drawer and lock it. Check that the drawer is securely held closed.

D. Warmer/Bassinet Interlock (model 3500 Only)

1. Lock the 3500 warmer's two rear casters.
2. Align the bassinet with the warmer .
3. Push the bassinet over the alignment/locking track of the warmer.
4. Continue pushing the bassinet until its locking pin drops into the socket at the end of the alignment track. There should be an audible click when the pin drops into position.
5. Lightly push and pull the bassinet to verify that the two units are securely held together.
6. Unlock the two rear casters on the warmer and check that the combined unit moves smoothly.

E. Warmer/Bassinet Unlock (Model 3500 Only)

1. Verify that the two bassinet front casters are unlocked.
2. With the locking pin handle (located at the rear of the bassinet) raised, pull the bassinet forward until it is fully detached from the warmer.

CAUTION ⚠ To prevent the drawers from opening unintentionally while moving the detached bassinet, move it from the front only.

F. Accessory Checks

Perform these checks if they are applicable.

1. Check that all accessories are mounted securely and that the load limits are not exceeded.
2. Check that all gas accessories are installed and operating properly. Check that the cylinders are mounted securely. Perform the leak check in section 5.8F.

   Check the output from the regulator(s) (refer to Section 4.4.)

3. If an Ohmeda airway manometer will be used, verify that it reads 0 Kpa at atmospheric pressure. If it is necessary to zero the manometer, unscrew the plastic bezel. Turn the screw located below the 4 Kpa mark on the dial face until the needle reaches zero. It may be necessary to loosen the two lower adjustment screws, adjust the needle by turning the upper screw, and re-tighten the two lower screws. A final fine adjustment may be necessary after the two lower screws are tightened. Be sure the lower screws are tight before using the manometer. Replace the bezel. Check that the manometer registers positive and negative pressures, and is not damaged or loose.

4. Where applicable, perform the checkout procedures detailed in the Operation and Maintenance Manuals for the accessories.

WARNINGS

⚠ **Overloading the shelves can affect the stability of the unit. Limit the load to 20 lbs. (9 kg) per instrument shelf, mounted to a single upright, and 50 lbs (23 kg) per monitor shelf, mounted between the uprights.**

⚠ **Limit the load of accessories to 50 lbs. (23 kg) per side of the infant warmer. Accessories should not be mounted more than 56 inches (142cm) above the floor. For models 3000 and 3500, limit the load of accessories to 20 pounds (9kg) maximum per side mounted no more than 44 inches (112cm) above the floor.**

⚠ **Due to the increased height of units with the ECMO option installed, a tipping hazard exists. Limit the total load of accessories to 50 lbs. (23 kg), no more than 25 lbs. (11 kg) per side of the infant warmer.**

G. Wall Mount Check Out Models 3050, 3100 and 3150

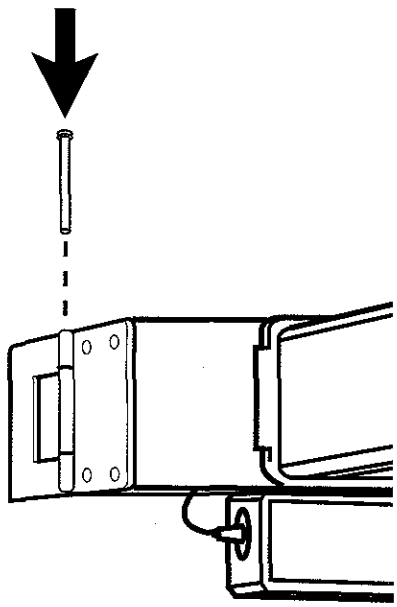
1. Verify that the heater assembly is rigidly secured to the wall and is level.

   Note: To access the control unit and display module for service procedures, hinge pins may be removed on one side or the other, allowing the warmer to pivot away from the wall to the service position.

2. Check that all hinge pins are in place and fully inserted with the pin heads at the top of the hinge.

WARNING

⚠ **In the service position, never place a patient in the bed when the heater is in the service position. Never leave the unit unattended in the service position or with either pin removed.**



CI.14.096

Figure 2-1
Wall mount pin insertion

2.2.2 Control Unit Checkout Procedure

A. Control Unit Check

1. *Connect the Infant Warmer power cord to an appropriate power source.* Refer to the rating plate on the Warmer System for the proper voltage needed. Switch the power On and verify the following on the Control Panel (Figure 2-2):
   a. The alternating two tone audible alarm sounds and all displays and indicators are lit for approximately two seconds.
   b. The software version appears in the elapsed time display.

      Note: During this time the controller also performs self check functions. If the controller detects a failure, the alarm stays on and service is required.

      Note: On units with HCA and HCC serial numbers, all alarms except system failure or powerfailure are preceded by a 30 second intermittent operator prompt tone.
   c. The manual mode indicator is lit.

      Note: The IWS 2001 International does not have a manual mode indicator.
   d. Operator prompt tones sound and the % power display flashes.

2. Adjust the heat output with the increase (▲) and decrease (▼) touch switches to *attain the high and low limits as indicated by the % power display.*

   Note: Steps 3 through 8 do not apply to the model 2001 international.

3. Connect the skin temperature probe to the warmer.

4. Press the mode switch to place the warmer in the servo mode and verify the following:

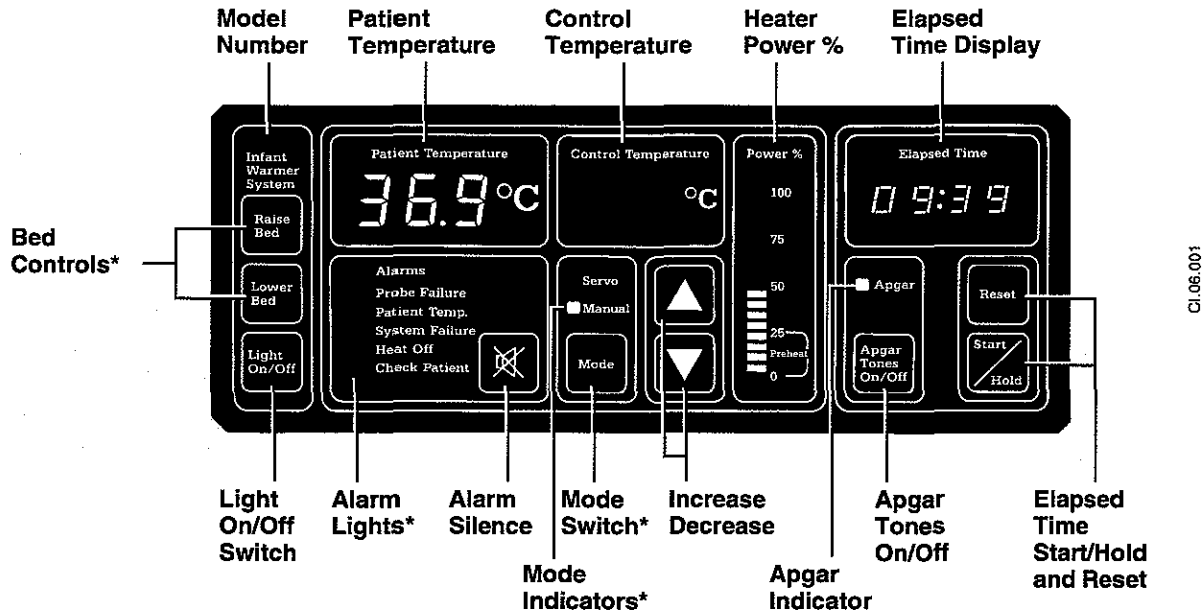
   Note: An alternating two tone alarm, a flashing overhead alarm light and the patient temperature display flashing "LL.L" or "HH.H" may occur here if the skin temperature probe is below 22°C. Warm the probe with your fingers or silence the alarm.
   a. The servo mode indicator is lit.
   b. An operator prompt tone sounds and the control temperature display flashes 36.5°C.

5. Press the increase (▲) touch switch and verify that the maximum servo control temperature attainable is 37.5°C.

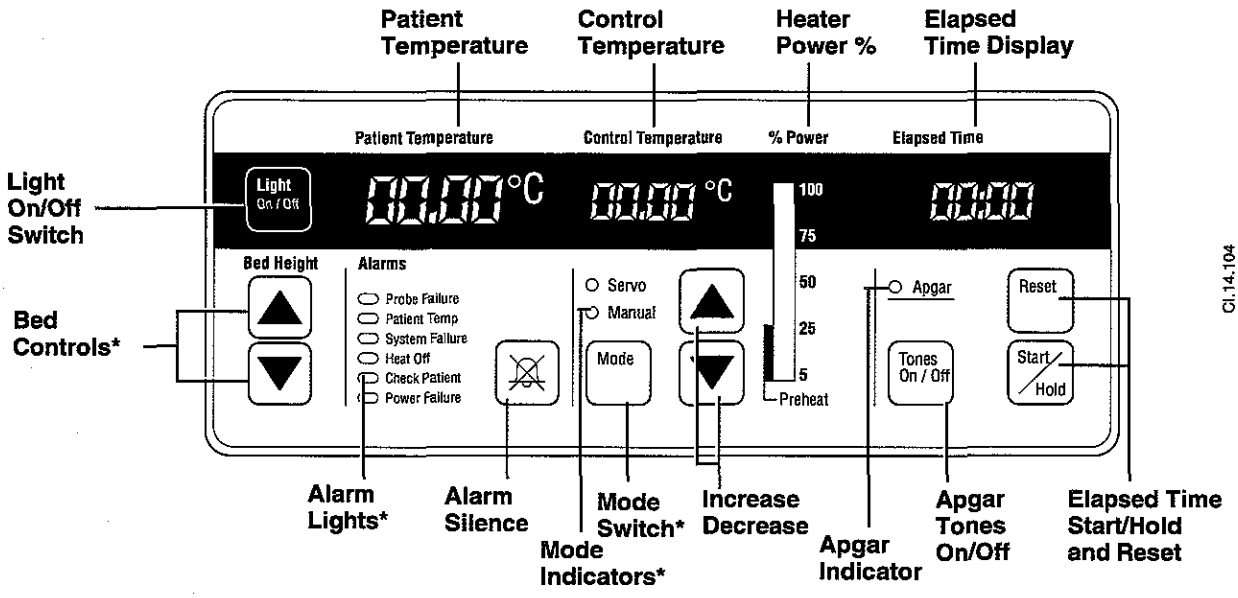
   Note: A patient temperature alarm occurs if the difference between the patient temperature and the control temperature is greater than 1°C (the alarm can be adjusted to 0.5°C by a qualified service person. Refer to Section 3.2, Changing the Patient Temperature Alarm Limits, for details).

6. *Press the decrease (▼) touch switch and verify that the minimum servo control* temperature attainable is 35.0°C.

Units with AAN, HAJ, HAK and HCA Serial Numbers



Units With HCC Serial Numbers



* Servo mode indicator, mode switch, and probe failure alarm are not present on the model 2001 international control panel. Bed raise/lower only present on elevating models.

Figure 2-2
Typical Infant Warmer System Control and Display Panel

7. Disconnect the skin temperature probe. Verify the following:
   a. The probe failure indicator light is lit.
   b. There is alternating two tone alarm.
   c. The overhead alarm light is lit.
   d. The patient temperature display flashes "HH.H".

8. Press the alarm silence switch and verify the following:
   a. The probe failure indicator light is lit.
   b. The audible alarm is silenced.
   c. The overhead alarm light is lit.
   d. The patient temperature display indicates "HH.H".
   e. After one minute, the alternating two tone alarm sounds, the overhead alarm flashes and the patient temperature display flashes "HH.H".
9. Switch to the manual mode and set the heat at 25% power.

B. Elapsed Timer Check

1. Press the Start/Hold touch switch to activate the elapsed timer. Verify that the timer starts operating.
2. Press the On/Off touch switch for the Apgar tones. Verify that the indicator light for the Apgar tones is extinguished.
3. Press the On/Off touch switch for the Apgar tones again. Verify that the indicator light for the Apgar tones is lit.
4. Press the Start/Hold touch switch. Verify that the present elapsed time is held.
5. Press the Start/Hold touch switch and verify that the timer updates to the current elapsed time and the Apgar tones continue to sound at the specified times (at 1 minute and at every 5 minute interval after the elapsed timer has started).
6. Press the Reset touch switch and verify that the timer indicates "00:00". If the elapsed timer is not used for approximately two minutes, the display switches off.

C. Observation Light Check

Press the Light On/Off touch switch. Verify that the observation light functions.

D. Raise and Lower Bed Switch Check (Elevating Models Only)

CAUTION ⚠ Do not continue to run the motor at the upper and lower limit positions; equipment damage may result.

1. Press the raise bed touch switch on the display and verify that the bed raises to a maximum of 46 1/2 inches (118 cm) off the floor.
2. Press the lower bed touch switch on the display and verify that the bed lowers to a minimum of 38 1/2 inches (98 cm) off the floor.
3. Verify that either foot switch (if present) raises and lowers the bed.

E. Interlock Switch Check

1. Place the Infant Warmer in the manual mode at 25% power output.
2. Rotate the heater assembly 90° to the side. Verify that the heater Off indicator light is On and the % power display indicates 0% heat.
3. Rotate the heater assembly to the normal operating position. Verify that the heat Off indicator light is Off and the % power display indicates 25%.

F. Power Failure, Memory Test and Battery Test

(For model 2001 international see next page)

1. Operate the unit in the manual mode with the heat set in the "pre-heat" range for a minimum of one hour to charge the battery.

Note: The battery must be fully charged to pass the ten minute test or partially charged to pass the two minute test. If the battery is defective, replace it with an Ohmeda NI-CAD rechargeable battery. There is no maintenance required for the battery. The battery has a two year replacement schedule.

CAUTION ⚠ Replace only with Ohmeda NI-CAD rechargeable Battery.

---

2. Disconnect the patient temperature probe.
3. Place the warmer in the servo mode.
4. Silence the probe failure alarm.
5. Set the control temperature at 37.0°C.
6. Remove the warmer power plug from the power source for two minutes. Do not switch the power Off. The power failure alarm should sound for two minutes and the power failure indicator (if present) should light.

   Note: If the power failure alarm is tested for ten minutes, the warmer must be connected to the correct power source and operated in the manual mode at the 0% heat setting for 24 hours to recharge the battery before allowing a patient to occupy the warmer.

   Note: The power failure alarm will not operate if the circuit breaker trips.

7. Reconnect the warmer to the power source. Verify the following:
   a. The warmer is operating in the servo mode.
   b. The control temperature is 37.0°C.
   c. The audio power failure alarm is Off.

Power Failure, Memory and Battery test for 2001 International model

1. Select 25% heater power.
2. Remove the warmer power plug from the power source for two minutes. Do not *switch the power OFF. The power failure alarm should* sound for two minutes, and the power failure indicator (if present) should light.
3. Reconnect the warmer to the power source and verify the following:
   a. *The heater is operating at 25% power.*
   b. The audio power failure alarm is off.

G. Calibration Check

1. Press and hold the Start/Hold touch switch for five seconds. On units prior to software revision level 4.01, press and hold the hidden switch on the control panel located directly above the alarm silence switch for two seconds.
2. Check the values in the display fields:
   a. The patient temperature reads 25.0 ± 0.3°C.
   b. The control temperature reads 37.9 ± 0.3°C

      Note: IWS 2001 International units do not have a control temperature display.
   c. The elapsed time display reads ten times % nominal line voltage ± 2%.

      Note: *Measure the outlet voltage and read the corresponding percent of your* unit's nominal voltage from the following table. The outlet voltage selects the row and the unit's nominal voltage sets the column. For example, if the line voltage measures 110 Vac for a 115 Vac nominal unit, the % nominal voltage *is* 95% and 950 ± 20 will appear in the elapsed time display.

Line (Outlet) Voltage				% Nom. Line Voltage x10
95V Nom.	115V Nom.	220V Nom.	230/240V Nom.	(Elapsed time display)
86	104	199	217	900 ± 20
87	105	201	219	910 ± 20
88	106	203	221	920 ± 20
89	107	205	224	930 ± 20
90	109	207	226	940 ± 20
91	110	210	229	950 ± 20
92	111	212	231	960 ± 20
93	112	214	233	970 ± 20
94	113	216	236	980 ± 20
95	114	218	238	990 ± 20
95	115	220	240	1000 ± 20
96	117	223	243	1010 ± 20
97	118	225	245	1020 ± 20
98	119	227	248	1030 ± 20
99	120	229	250	1040 ± 20
100	121	232	253	1050 ± 20
101	122	234	255	1060 ± 20
102	124	236	257	1070 ± 20
103	125	238	260	1080 ± 20
104	126	240	262	1090 ± 20
105	127	243	265	1100 ± 20

3.‡ Check the RS-232 circuitry. Short pins 2 and 3 of the RS-232/Nurse Call connector. Press the Apgar Tones switch while powering up the unit. Release the switch when a continuous alarm sounds. If the RS-232 option is functioning, the temperature displays will cycle to a frame that shows "rs 232 PASS".* Conversely, if the RS-232 circuitry is not functioning or is not installed, the temperature displays will cycle to frame that shows "rs 232 FAIL". Turn off the unit to exit this test mode. Remove short from pins 2 and 3.

4.‡ Check the Nurse Call circuitry by rotating the heater to the X-ray position to trigger a heater off alarm. Under the "no alarm" condition, verify contact closure between pins 1 and 6 and no contact closure between pins 1 and 9 of the RS-232/Nurse Call connector. Under the alarm condition, verify contact closure between pins 1 and 9 and no contact closure between pins 1 and 6.

‡ Option available only on units with software revision 5.00.

* On units with boards with no test switch, the first pass through may indicate "rs 232 FAIL" due to the varying warm-up times of the ThermaLink board and the control board. Do not shut the unit off; continue to run the test. If the ThermaLink board is functioning correctly, the display should show "rs 232 PASS" in all subsequent cycles.

3/Infant Warmer Modifications

This section describes how to reconfigure standard warmers to meet special clinical needs.

3.1 Converting Units for Operating Room Use

Reversing the display module's display panel allows an anesthesiologist to monitor patient temperature. If this operating room conversion is desired, follow the next steps.

A. Disassembly for Reversal

1. Remove all 4 mounting screws from the bottom of the display module and set them aside.

2. Disassemble the display module, performing steps 1 through 7 in section 5.2C - "Display Module Disassembly".

3. Remove both the control board and power supply boards, performing all the steps in section 5.2B - "Control Board Removal" and "Power Supply Board Removal".

For units with Software Revision 4.01 or higher, perform steps 4 through 6.

4. *Thread the shielded display ribbon cable out of the slot in the top of the display* module. Set aside the 2 spring clips that secure it to the shield. See Figure 5-10.

5. Remove the nuts and washer that secure the display board to the ESD shield. Remove the ground wire, if present.

6. Separate the display board from the ESD shield, but leave the ribbon cable connected to the display board.

B. Ribbon Cable Preparation (Only for units with Software Revision 4.01 of higher)

1. Peel back the foil ESD shielding wrapped around the ribbon cable, taking care not to tear it.

2. Untwist the bend in the ribbon cable, so that the cable lies flat.

3. Re-wrap the foil ESD shielding around the cable, taking care to keep the shielding as close to the control board end connector as possible

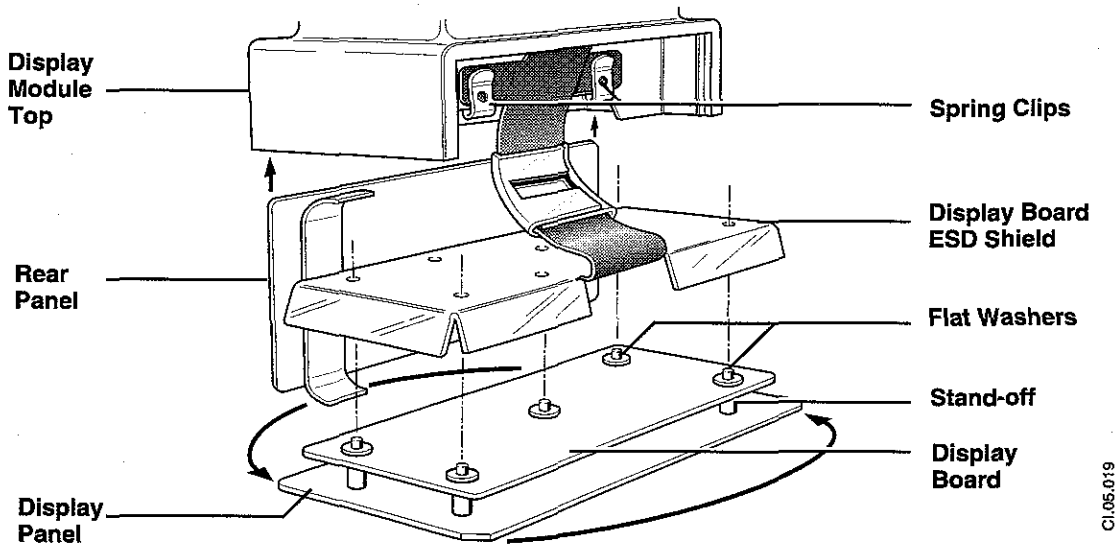


Figure 3-1
Turning the Display Board

C. Reversing the Display

For units prior to Software Revision 4.01, omit steps 1 through 6.

1. Place 2 flat washers on each of the display board stand-offs.

2. Attach the assembled display board and display panel to the ESD shield, turning them 180° as shown in Figure 3-1, so that the display panel assembly stand-offs fit the second set of holes in the shield. Figure 5-10 shows the ground wire attached to the top left stand-off. Reattach the ground wire (if present) to the bottom right stand-off as shown in Figure 3-2.

3. Thread the flattened ribbon cable through the rectangular slot formed by the folded-in flaps of the control board ESD shield and through the matching slot in the shield.

4. Thread the display board ribbon cable through the slot in the top of the display module and the slot in the control board shield. Pull any slack in the ribbon cable back up into the control unit, so that the end of the cable's foil wrapped shielding shows in the middle of the slot in the folded-in flaps. See Figure 3-2.

5. Flip over the reassembled display board, display panel assembly and display ESD shield , and slide it into the slot in the back of the display module top, so the display panel faces back, away from the warmer bed. The ribbon cable will now pass in front of the unshielded side of the display board, not behind it as it would in standard display module orientation.

6. Figure 5-5 shows the ribbon cable secured to the ESD shield with both spring clips on the right side of the cable. Re-secure the ribbon cable with a spring clip on either side of where the cable passes through the rectangular slot in the display board ESD shield. See Figure 3-2.

7. Slide the rear panel into the slot in the front of the display module top, so that it faces toward the warmer bed.

8. Reattach the display board ground wire (if present) to the fastons on the rear display panel. Verify that the 2 spring clips that secure the display board ESD shield to the display module top cover, and the 2 spring clips that hold the display ribbon cable to the ESD shield, are still firmly in place.

9. Reinstall the bottom cover of the display module. Be careful not to over tighten the 4 cover mounting screws.

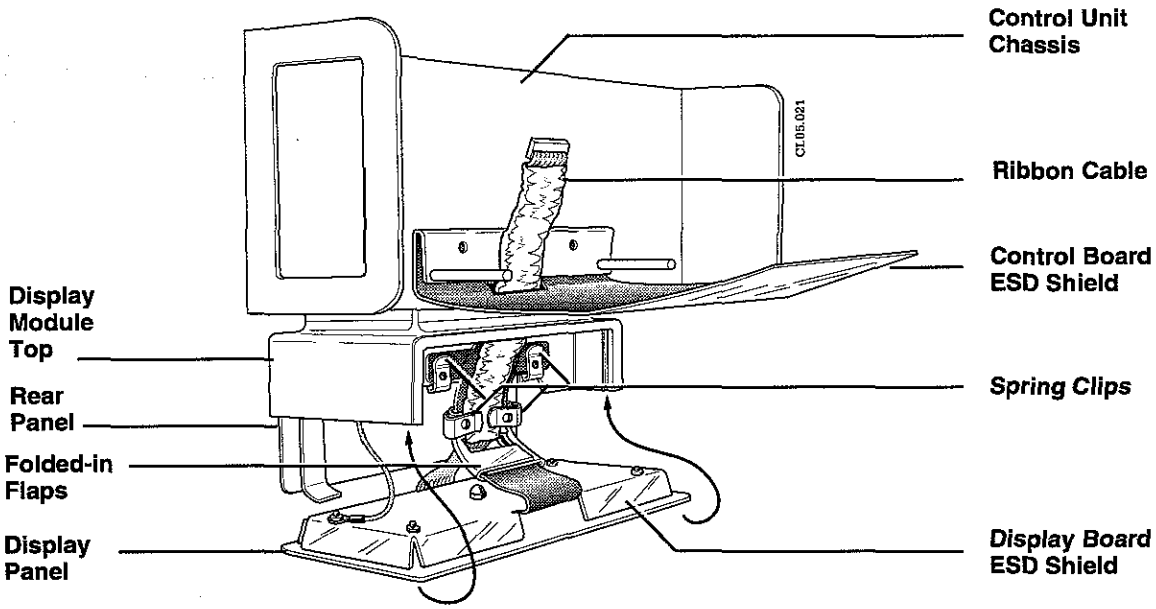


Figure 3-2
Flipping the display

D. Control Unit Reassembly

1. Install the power supply board, performing all the steps in 5.2B- "Power Supply Board Installation".

2. Install the control board, performing all the steps in 5.2B - "Control Board Installation".

3. Complete Section 2.2.2 control unit checkout procedure prior to putting the unit back in service

3.2 Changing Patient Temperature Alarm Limits

(See Figure 3-3)

The patient temperature alarm occurs if the difference between the patient temperature and the control temperature is greater than 1°C. This procedure allows that difference to be adjusted to 0.5°C.

Note: This procedure does not apply to IWS 2001 International units, which are manual mode only warmers and do not have patient temperature alarms.

1. Disconnect the power cord from the AC power source.
2. Remove the control cover. Fold down the ESD shield (if present) to access the control board.
3. If the dipswitch on the control board has 8 switches, set switch 4 to ON. If the dipswitch has 4 four switches, set 1 and 2 ON, and 3 and 4 OFF.
4. Bend the ESD shield (if present) back up into place.
5. Replace the 2 cover screws for the control unit cover.
6. Complete Section 2.2.2 control unit checkout procedure prior to putting the unit back in service.

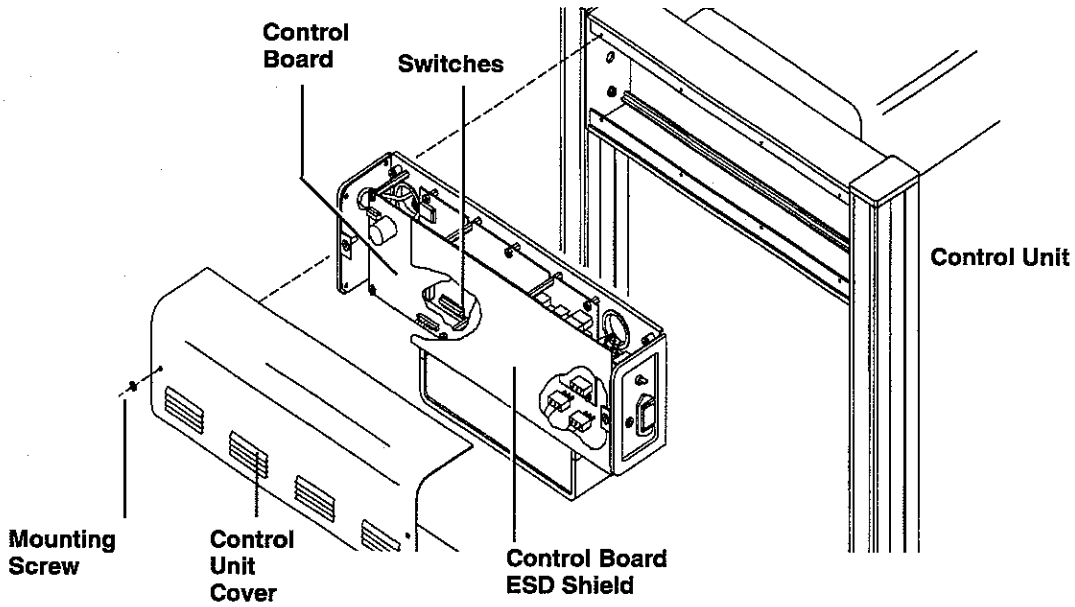


Figure 3-3
Accessing Control Board Switches

3.3 Lowering Heater and Bed Height

(Non-elevating Models Only)

A. Control Module Removal

(See Figure 5-6)

1. Disconnect the warmer power cord from the AC power source.

2. Remove the two center mounting screws from the bottom of the display module.

3. Remove the two mounting screws for the control unit cover and remove the cover. Fold the ESD shield, if present, down away from the control board.

4. Disconnect the two connectors, J17 and the three pin chassis connector for the observation light to the right of the power board. Squeeze the locking tabs on the rear of the plug to disengage the lock mechanism.

5. Loosen the four corner mounting screws for the control unit and carefully remove the control module. Place the control unit on a flat surface so it rests on the transformers.

B. Heater and Bed Height Adjustment

1. To adjust bed height, remove the eight mounting screws on the back of the lower cross bar extrusion, remove the rear cover plate, and set them aside.

2. Loosen the ground screw(s) on the inside left and right hand sides of the lower and upper cross bar extrusions.

3. On the lower cross bar extrusion, loosen the upper and lower nuts of the left and right locking lug assemblies. Carefully adjust the bed height by moving the lower cross bar down until the desired floor to bed mattress height is achieved.

4. On the lower cross bar extrusion, retighten the upper and lower nuts of the left and right locking lug assemblies and torque to 125 ± 5 lb-in.

   Note: On model 4300 warmers with a rotating drawer package installed, the support post under the bed casting (behind the drawers) must also be removed and cut down to a shorter length. After the modification a new support post must be ordered to raise the bed height once again.

5. To adjust heater height, loosen the upper and lower nuts of the left and right locking lug assemblies on the upper cross bar extrusion. Carefully adjust the heater height by moving the upper cross bar down until the distance from the heater grill to center of the bed mattress is 27 ± 2 in. (69 ± 5cm).

WARNING ⚠ **Bed to heater spacing which differs from the specified 27 inches ± 2 inches (69 ± 5cm) will result in incorrect operation and may adversely affect patient condition.**

---

6. On the upper cross bar extrusion, retighten the upper and lower nuts of the left and right locking lug assemblies and torque to 125 ± 5 lb-in.

7. Retighten the ground screws on the inside left and right hand sides of the lower and upper cross bar extrusions and torque to 25 ± 5 lb-in.

8. Replace the rear cover plate on the back of the lower cross bar extrusion and tighten in place using the eight mounting screws set aside in step 1 above.

C. Control Module Replacement

(See Figure 5-6)

1. Carefully place the control module in position and tighten the four mounting screws for the control unit.
2. Reconnect the two connectors, J17 and the three pin chassis connector to the right of the power board to the power supply board.
3. Hold the display module in position and replace the two inside mounting screws on the bottom.
4. Bend the ESD shield (if present) back up into place.
5. Place the control unit cover in position and replace the two mounting screws.
6. Perform the electrical safety and the calibration procedures in Section 4. Perform the checkout procedures detailed in Section 2.2.

4/Calibration and Adjustments

4.1 Maintenance Schedule

The unit should be maintained in accordance with the procedures detailed in this manual. Service maintenance must be performed by a technically competent individual as described on page ii.

This schedule lists the minimum frequencies. Always follow hospital and local regulations for required frequencies.

Per hospital protocol	Perform the electrical safety and checkout procedure from this manual.
Biannually	Check the calibration as detailed in this manual.
Annually	Inspect the casters to ensure they are structurally sound and firmly support the equipment. They should move freely and roll smoothly. Replace worn or loose casters.
Annually	Inspect the yoke strainer nipples and replace if necessary (On models equipped with gas package).
Every two years	Replace the battery.
Every five years	Replace the regulator(s) (On models equipped with gas package).

IWS models shipped with Serial Number HCA or HCC have a electronic controller common to all models. This change was made to simplify servicing future IWS models, to incorporate changes necessary to comply with international standards, and to minimize susceptibility to EMI.

IWS units with software revision 06.00 and higher have a controller board identified by a eight position dip switch, surface mounted components (SMT), and a 12 pin pin test connector. Refer to section 4.2 for calibration and adjustment of this controller board.

All IWS units with software revision 4.01 through 05.10 have controller board identified by the presence of an eight position dip switch, through hole components, and a 7 pin test connector. Refer to Section 4.3 for calibration and adjustment of this controller board.

To facilitate service of IWS product with a controller board software revision prior to 4.01, a separate section on Calibration and Adjustment has been included. This older controller board is identified by the four position dip switch. Refer to Section 4.4 for calibration and adjustment of Infant Warmers with this controller board.

WARNING ⚠ **Use extreme care while performing calibration and adjustment procedures, or while working on the Infant Warmer System with power connected. An electrical shock hazard does exist; be certain to observe all safety precautions.**

CAUTION Ⓧ Use the Static Control Work Station (Stock No. 0175-2311-000) to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

Note: The audio alarm will sound for about 2 seconds whenever powering up the unit.

Note: Warm up the unit for 5 minutes before making these adjustments.

4.2 Controller Calibration (Software Revision 06.00 or higher)

This section is to be used for calibration and adjustment of Infant Warmer Systems with Software Revision "6.00" or higher. Refer to Section 8 for detailed circuit diagrams.

The controller board contains an eight position dip switch. The state or configuration of each switch position may change, i.e. On or Off, during the calibration procedure, depending on the adjustment procedure. The function of each switch position and the normal state is given below:

Switch Position ***Function***	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
PTG Alarm 1.0 °C	X	X	X	0	X	X	0	0
PTG Alarm 0.5 °C	X	X	X	1	X	X	0	0
RS-232 Normal Mode	X	X	X	X	X	0	0	0
RS-232 Reserved	X	X	X	X	X	1	X	X
Normal Operation	X	X	X	X	X	X	0	0
Service Loop/ RS 232 Diagnostics Mode	X	X	X	X	X	X	0	1
A/D Calibration Loop/ RS-232 Diagnostics Mode	X	X	X	X	X	X	1	0
Line Volt Cal Loop/ RS-232 Diagnostic Mode	X	X	X	X	X	X	1	1

X= no effect (but should remain in "Off" position) 0= Off 1= On

4.2.1 Control Unit Access

1. Disconnect the power cord for the Infant Warmer System from the wall outlet.
2. Remove the mounting screws for the controller cover. Remove the controller cover.
3. Fold the ESD shield down (if present), away from the controller board.
4. Note the positions of the test switch SW1 located on the control board before performing the operations in this section. Be sure to replace the test switch to these original positions before returning the unit to service.

4.2.2 Power Supply Board Voltages

1. All eight positions on test switch (SW1) should be Off.
2. Connect the controller assembly to an appropriately rated power source (listed voltage ± 10%), and switch the power switch On.

   Note: You will go through the normal start up routine. Patient temperature alarms may trigger.
3. Check that the following dc voltages are present at the test connector (TP1) located on the control board. Voltages should be within the tolerances specified; otherwise follow the recommended corrective action:

Test Point	Reading	Corrective action
TP9 Ground (common)	—	—
TP5 (9.0 Vdc ST.)	9 ± 0.2 Vdc	adjust R4 on Power Supply PCB
TP4 (5.0 Vdc LEDS)	5 ± 0.3 Vdc	replace Power Supply PCB
TP1 (5.0 Vdc ST.)	5 ± 0.3 Vdc	replace Power Supply PCB

4. If no corrective actions are required, continue with Section 4.2.3, Display Brightness, at step 2.

4.2.3 Display Brightness Check

Note: The display brightness is pre-calibrated at the factory and should only require adjustment if replacing a component on the display board.

Test Procedure

1. All eight positions on controller board dip switch (SW1) should be Off. Connect the *controller assembly to an appropriately rated power source* and switch the power switch On.
2. Hold the Alarm Silence switch down for five seconds.
3. Check that all the displays are illuminated and are of uniform brightness.

   Note: IWS 2001 International units do not have a control temperature display, servo mode indicator, or probe failure indicator.
4. If the displays are acceptable proceed to Section 4.2.4, Alarm Volume, at step 2. If the displays are not illuminated adequately proceed with the adjustment procedure.

Adjustment Procedure

CAUTION ⚠ The back panel and display panel may drop down when the bottom cover mounting screws are removed. Be sure to secure the panels with tape before disassembly.

1. Switch the power switch Off and unplug the unit.
2. Tape the display panel and back panel to the top cover.
3. Remove the four outside corner mounting screws from the bottom of the display panel. Do not remove the two inside mounting screws. Remove the bottom display cover by sliding it down.
4. Fold out the bottom edge of the ESD shield to access the display board. Connect a digital voltmeter across R13 or connector J23, located near the right edge of the display board.
5. Connect the controller assembly back to the appropriately rated power source.
6. Depress and hold down the Start/Hold switch while you switch the power switch On to enter the ADC calibration routine. "CAL" appears in the patient temperature display and "AdC" appears in the control temperature display.
7. Adjust R1 on the display board until the voltage across R13 (J23) is 3.30 ± 0.2 Vdc.
8. Switch the power switch Off and then back On and verify that all segments of all displays are illuminated and are of uniform brightness.
9. Switch the power switch Off.
10. Fold the edge of the ESD shield back into place. Replace the bottom of the display panel using the four screws previously removed.
11. Continue with Section 4.2.4, Alarm Volume, at step 2.

4.2.4 Alarm Volume

WARNING ⚠ **Lowering the volume excessively may prevent caregivers from hearing alarms. The alarm volume and frequency are precalibrated at the factory for both replacement boards and controllers. Volume adjustments should not normally be required in the field.**

Test Procedure

1. All eight positions on controller board dip switch (SW1) should be Off. Switch the Infant Warmer On.
2. Activate the alarm by selecting the servo mode and unplugging the patient probe, or alternatively, hold down the Alarm Silence switch for five seconds (IWS 2001 International models). You should hear an intermittent tone for the first 30 seconds, followed by an alternating two tone alarm.
3. Ensure the alarm tone and volume are at the desired levels. Verify that the audio alarm level is adequate in a location with a background noise level of 55 dBA max. If the audio alarm level is acceptable, continue with Section 4.2.5, Analog to Digital Converter Calibration, at step 3. If the audio alarm level is unacceptable, continue with the adjustment procedure.

Adjustment Procedure

1. Switch the power switch Off.
2. All eight positions on controller board dip switch (SW1) should be Off.

   Depress and hold down the Start/Hold switch while you switch the power switch On to enter the *ADC calibration routine.*
3. Verify that the frequency at pin 8 of the control board test connector TP1 is 2.050 kHz ± 0.1 kHz. Adjust RP4 on the control board as required to achieve the desired frequency.
4. Adjust volume to maximum with RP1. The factory seting is 92 ± 4 dBa , and lower settings are not recommended.
5. Continue with Section 4.2.5, Analog to Digital Converter Calibration.

4.2.5 Analog to Digital Converter (ADC) Calibration

4.2.5.1 Verification

1. Switch the power switch Off.
2. All eight positions on controller board dip switch (SW1) should be Off.

   Connect the controller assembly to an appropriately rated power source and switch the power switch On and allow the unit to stabilize for 5 minutes.
3. Connect the following resistances to the patient jack and verify the patient temperature readings:

Resistance	Switch Setting	Patient Temperature Display
5496 ± 0.1%	I2	39.0 ± 0.1 degrees
7060 ± 0.1%	I3	33.0 ± 0.1 degrees
5900 ± 0.1%	I7	37.3 ± 0.1 degrees
6190 ± 0.1%	I11	36.2 ± 0.1 degrees

4. Depress the Start/Hold switch for five seconds.
5. Verify that the correct values appear for the cal low and cal high resistors:

   Patient temp: 25.0 ± 0.3°C (cal low signal; 1 decimal place)

   Control temp: 37.9 ± 0.3°C (cal high signal; 1 decimal place)

   Note: Only the cal low reading appears on IWS 2001 International units, which do not have a control temperature display.
6. If the displayed values are within tolerances, continue with Section 4.2.6, Line Voltage Compensation. Otherwise, record if the temperatures differ from their target values by more than a half degree centigrade and continue with the adjustment procedure, with one of the following methods. The quicker method in 4.2.5.3 requires a 0.1% accurate resistance decade box. The older method in 4.2.5.2 requires the Ohmeda Temperature Simulator Box.

4.2.5.2 Adjustment Procedure (with Ohmeda Temp. Simulator Box)

Note: If the unit is cold, let it operate for five minutes before starting this adjustment.

1. Switch the power switch Off.
2. Depress and hold down the Start/Hold switch while you switch the power switch On to enter the ADC calibration routine.
3. Connect a resistance of 5900 ± 0.1% to the patient probe connector with switch setting I7 on the Ohmeda Temperature Simulator Box. Adjust RP3 to obtain a reading of 37.37 ± 0.02°C in the elapsed time display.

   Note: The decimal point does not appear. Although the tolerance is ± 0.02°C, the readings should be adjusted as closely as possible to the nominal value; the ± 0.02°C allows for variation in measured temperature due to system noise, etc.
4. Connect a resistance of 7686 ± 0.1% to the patient probe connector with switch setting I1 on the Ohmeda Temperature Simulator Box. Adjust RP2 to obtain a reading of 31.09 ± 0.02°C in the elapsed time display.
5. Repeat steps 3 and 4 until no further adjustment is required.
6. Switch the power switch Off, wait 5 seconds and switch the power switch back On.
7. Connect the following resistances to the patient probe connector and verify the correct temperature readings appear in the patient temperature display.

Resistance	Switch Setting	Patient Temperature Display
5496 ± 0.1%	(I2)	39.0 ± 0.1 degrees
7060 ± 0.1%	(I3)	33.0 ± 0.1 degrees
5900 ± 0.1%	(I7)	37.3 ± 0.1 degrees
6190 ± 0.1%	(I11)	36.2 ± 0.1 degrees

   Note: The resistance values shown above are available on the Ohmeda Temperature Simulator Box. The switch positions are listed in parentheses.
8. Continue with Section 4.2.6, Line Voltage Compensation.

4.2.5.3 Adjustment Procedure (with a 0.1% accurate resistance decade box)

1. Check the readings from the calibration resistors. Depress and hold the Start/Hold switch for 5 seconds until the proper calibration readings appear in the patient and air temperature displays:

   Patient Temperatue 25.05 ± 0.2 °C

   Air Temperature 37.97 ± 0.2°C

   If these values are in tolerance, no calibration is necessary (skip to section 4.2.6)

2. Adjust the resistance decade box to 2.980K ohms and plug into the patient sensor jack.
3. Turn power off and press Start/Hold while turning power on.
4. Adjust pot RP3 until the control temperature display toggles between 000 and 001.
5. Set the resistance decade box to a 32.789K ohm resistance and plug into the patient sensor jack.
6. Adjust pot RP2 until the control temperature display toggles between F9E and F9F.
7. Check accuracy with the following values:

Resistance Input (ohms)	Patient Temperature Display
5509	39.0± 0.1°C
5981	37.0
6500	35.0

8. Disconnect the resistance box from the patient probe jack.
9. Switch the unit off. Calibration is complete.

4.2.6 Line Voltage Compensation

WARNING ⚠ **Use extreme care while performing calibration and adjustment procedures, or while working on the Infant Warmer System with power connected. An electrical shock hazard does exist; be certain to observe all safety precautions.**

Test Procedure

1. Switch the power switch Off.
2. All eight positions on dip switch (SW1) should be Off.
3. Use a Digital Volt Meter and measure the line voltage at the wall outlet.
4. Connect the controller assembly to an appropriately rated power source and switch the power switch On.
5. Read the corresponding percent of your unit's nominal voltage from the following table. The outlet voltage selects the row and the unit's nominal voltage selects the column. For example, if the line voltage measures 110 Vac for a 115 Vac nominal unit, the % nominal voltage is 95% and 950 ± 20 should appear in the elapsed time display in step 7.

   Note: Record this value from the table for later use.

Line (Outlet Voltage)				% Nominal (Nom.) Line Voltage x10 (Elapsed time display)
95V Nom.	115V Nom.	220V Nom.	230/240V Nom.	
86	104	199	217	900±20
87	105	201	219	910±20
88	106	203	221	920±20
89	107	205	224	930±20
90	109	207	226	940±20
91	110	210	229	950±20
92	111	212	231	960±20
93	112	214	233	970±20
94	113	216	236	980±20
95	115	220	240	1000±20
96	117	223	243	1010±20
97	118	225	245	1020±20
98	119	227	248	1030±20
99	120	229	250	1040±20
100	121	232	253	1050±20
101	122	234	255	1060±20
102	124	236	257	1070±20
103	125	238	260	1080±20
104	126	240	262	1090±20
105	127	243	265	1100±20

6. Depress the Start/Hold switch for five seconds.

7. Verify that the value in the elapsed time display equals the percent of nominal voltage read from the table in step 5.

8. If the displayed values are within tolerances, continue with Section 4.4, Oxygen/Air Regulator Checks and Adjustments. Otherwise, continue with the adjustment procedure below.

Adjustment Procedure

1. Switch the power switch Off.

2. Depress and hold down the Reset switch while you switch the power switch On to enter the % Line Voltage Calibration routine.

3. Slowly adjust R3 on power supply board as required until the elapsed time display equals the value read from the table in step 5 of the test procedure.

4. Continue with Section 4.3, Oxygen/Air Regulator Checks and Adjustments.

4.3 Controller Calibration (Software Revision 04.01 through 05.10)

This section is to be used for calibration and adjustment of Infant Warmer Systems with Software Revision "4.01" through "5.10". Refer to Section 8 for detailed circuit diagrams.

The controller board contains an eight position dip switch. The state or configuration of each switch position may change, i.e. On or Off, during the calibration procedure, depending on the adjustment procedure. The function of each switch position and the normal state is given below:

Switch Position / Function	1	2	3	4	5	6	7	8
PTG Alarm 1.0 °C	X	X	X	0	X	X	0	0
PTG Alarm 0.5 °C	X	X	X	1	X	X	0	0
RS-232 Normal Mode	X	X	X	X	X	0	0	0
RS-232 Reserved	X	X	X	X	X	1	X	X
Normal Operation	X	X	X	X	X	X	0	0
Service Loop/	X	X	X	X	X	X	0	1
RS 232 Diagnostics Mode								
A/D Calibration Loop/	X	X	X	X	X	X	1	0
RS-232 Diagnostics Mode								
Line Volt Cal Loop/	X	X	X	X	X	X	1	1
RS-232 Diagnostic Mode								

X= no effect (but should remain in "Off" position) 0= Off 1= On

4.3.1 Control Unit Access

1. Disconnect the power cord for the Infant Warmer System from the wall outlet.
2. Remove the mounting screws for the controller cover. Remove the controller cover.
3. Fold the ESD shield down (if present), away from the controller board.
4. Note the positions of the test switch S1 located on the control board before performing the operations in this section. Be sure to replace the test switch to these original positions before returning the unit to service.

4.3.2 Power Supply Board Voltages

1. All eight positions on test switch (S1) should be Off.
2. Connect the controller assembly to an appropriately rated power source (listed voltage ± 10%), and switch the power switch On.

   Note: You will go through the normal start up routine. Patient temperature alarms may trigger.
3. Check that the following dc voltages are present at the test connector (T1) located on the control board. Voltages should be within the tolerances specified; otherwise follow the recommended corrective action:

Test Point	Reading	Corrective action
TP7 Ground (common)	—	—
TP3 (9.0 Vdc ST.)	9 ± 0.2 Vdc	adjust R4 on Power Supply PCB
TP4 (5.0 Vdc LEDS)	5 ± 0.3 Vdc	replace Power Supply PCB
TP5 (5.0 Vdc ST.)	5 ± 0.3 Vdc	replace Power Supply PCB

4. If no corrective actions are required, continue with Section 4.3.3, Display Brightness, at step 2.

4.3.3 Display Brightness Check

Note: The display brightness is pre-calibrated at the factory and should only require adjustment if replacing a component on the display board.

Test Procedure

1. All eight positions on controller board test switch (S1) should be Off. Connect the controller assembly to an appropriately rated power source and switch the power switch On.
2. Hold the Alarm Silence switch down for five seconds.
3. Check that all the displays are illuminated and are of uniform brightness.

   Note: IWS 2001 International units do not have a control temperature display, servo mode indicator, or probe failure indicator.
4. If the displays are acceptable proceed to Section 4.3.4, Alarm Volume, at step 2. If the displays are not illuminated adequately proceed with the adjustment procedure.

Adjustment Procedure

CAUTION

⚠ The back panel and display panel may drop down when the bottom cover mounting screws are removed. Be sure to secure the panels with tape before disassembly.

1. Switch the power switch Off and unplug the unit.

2. Tape the display panel and back panel to the top cover.

3. Remove the four outside corner mounting screws from the bottom of the display panel. Do not remove the two inside mounting screws. Remove the bottom display cover by sliding it down.

4. Fold out the bottom edge of the ESD shield to access the display board. Connect a digital voltmeter across R10, located on the bottom edge of the display board.

5. Connect the controller assembly back to the appropriately rated power source.

6. Depress and hold down the Start/Hold switch while you switch the power switch On to enter the ADC calibration routine. "CAL" appears in the patient temperature display and "AdC" appears in the control temperature display.

7. Adjust R9 on the display board until the voltage across R10 is 3.30 ± 0.2 Vdc.

8. Switch the power switch Off and then back On and verify that *all* segments of *all* displays are illuminated and are of uniform brightness.

9. Switch the power switch Off.

10. Fold the edge of the ESD shield back into place. Replace the bottom of the display panel using the four screws previously removed.

11. *Continue with Section 4.3.4, Alarm Volume, at step 2.*

4.3.4 Alarm Volume

WARNING ⚠ **Lowering the volume excessively may prevent caregivers from hearing alarms. The alarm volume and frequency are precalibrated at the factory for both replacement boards and controllers. *Volume adjustments should* not normally be required in the field.**

Test Procedure

1. All eight positions on controller board test switch (S1) should be Off. Switch the Infant Warmer On.

2. Activate the alarm by selecting the servo mode and unplugging the patient probe, or alternatively, hold down the Alarm Silence switch for five seconds (IWS 2001 International models). You should hear an intermittent tone for the first 30 seconds, *followed by an alternating two tone alarm.*

3. Ensure the alarm tone and volume are at the desired levels. Verify that the audio alarm level is adequate in a location with a background noise level of 55 dBA max. *If the audio alarm level is acceptable, continue with Section 4.3.5, Analog to Digital Converter Calibration, at step 3.* If the audio alarm level is unacceptable, continue with the adjustment procedure.

Adjustment Procedure

1. Switch the power switch Off.
2. All eight positions on controller board test switch (S1) should be Off.

   Depress and hold down the Start/Hold switch while you switch the power switch On to enter the ADC calibration routine.
3. Verify that the frequency at pin 1 of the control board test connector is 2.050 kHz ± 0.1 kHz. Adjust R38 on the control board as required to achieve the desired frequency.
4. Continue with Section 4.3.5, Analog to Digital Converter Calibration.

4.3.5 Analog to Digital Converter (ADC) Calibration

1. Switch the power switch Off.
2. All eight positions on controller board test switch (S1) should be Off.

   Connect the controller assembly to an appropriately rated power source and switch the power switch On and allow the unit to stabilize for 5 minutes.
3. Connect the following resistances to the patient jack and verify the patient temperature readings:

Resistance	Switch Setting	Patient Temperature Display
5496 ± 0.1%	I2	39.0 ± 0.1 degrees
7060 ± 0.1%	I3	33.0 ± 0.1 degrees
5900 ± 0.1%	I7	37.3 ± 0.1 degrees
6190 ± 0.1%	I11	36.2 ± 0.1 degrees

4. Depress the Start/Hold switch for five seconds.
5. Verify that the correct values appear for the cal low and cal high resistors:

   Patient temp: 25.0 ± 0.3°C (cal low signal; 1 decimal place)

   Control temp: 37.9 ± 0.3°C (cal high signal; 1 decimal place)

   Note: Only the cal low reading appears on IWS 2001 International units, which do not have a control temperature display.
6. If the displayed values are within tolerances, continue with Section 4.3.6, Line Voltage Compensation. Otherwise, record if the temperatures differ from their target values by more than a half degree centigrade and continue with the adjustment procedure.

Adjustment Procedure

Note: If the unit is cold, let it operate for five minutes before starting this adjustment.

1. Switch the power switch Off.
2. Depress and hold down the Start/Hold switch while you switch the power switch On to enter the ADC calibration routine.
3. Connect a resistance of 5900 ± 0.1% to the patient probe connector.

   Note: 5900 ± 0.1% is switch setting I7 on the temperature simulator box.
4. If the temperature displays in the calibration check differed from the target values by less than half a degree centigrade, continue with step 5. Otherwise:
   a. Connect a voltmeter between pins 10 and 7 of the control board test connector.
   b. Set the voltage at TP10 to 2.000 Vdc by adjusting R44.
   c. Connect the voltmeter between pins 9 and 7 of the control board test connector.
   d. Set the voltage at TP9 to 0.368 Vdc by adjusting R52. Then, disconnect the voltmeter.
5. Connect a resistance of 5900 ± 0.1% to the patient probe connector. Adjust R52 to obtain a reading of 37.37 ± 0.02°C in the elapsed time display.

   Note: The decimal point does not appear. Although the tolerance is ± 0.02°C, the readings should be adjusted as closely as possible to the nominal value; the ± 0.02°C allows for variation in measured temperature due to system noise, etc.
6. Connect a resistance of 7686 ± 0.1% to the patient probe connector. Adjust R44 to obtain a reading of 31.09 ± 0.02°C in the elapsed time display.

   Note: 7686 ± 0.1% is switch setting I1 on the temperature simulator box.
7. Repeat steps 5 and 6 until no further adjustment is required.
8. Switch the power switch Off, wait 5 seconds and switch the power switch back On.
9. Connect the following resistances to the patient probe connector and verify the correct temperature readings appear in the patient temperature display.

Resistance	Switch Setting	Patient Temperature Display
5496 ± 0.1%	(I2)	39.0 ± 0.1 degrees
7060 ± 0.1%	(I3)	33.0 ± 0.1 degrees
5900 ± 0.1%	(I7)	37.3 ± 0.1 degrees
6190 ± 0.1%	(I11)	36.2 ± 0.1 degrees

   Note: The resistance values shown above are available on the Temperature Simulator. The switch positions are listed in parentheses.

10. Continue with Section 4.3.6, Line Voltage Compensation.

4.3.6. Line Voltage Compensation

WARNING

⚠ **Use extreme care while performing calibration and adjustment procedures, or while working on the Infant Warmer System with power connected. An electrical shock hazard does exist; be certain to observe all safety precautions.**

Test Procedure

1. Switch the power switch Off.
2. All eight positions on test switch (S1) should be Off.
3. Use a Digital Volt Meter and measure the line voltage at the wall outlet.
4. Connect the controller assembly to an appropriately rated power source and switch the power switch On.
5. Read the corresponding percent of your unit's nominal voltage from the following table. The outlet voltage selects the row and the unit's nominal voltage selects the column. For example, if the line voltage measures 110 Vac for a 115 Vac nominal unit, the % nominal voltage is 95% and 950 ± 20 should appear in the elapsed time display in step 7.

   Note: Record this value from the table for later use.

Line (Outlet Voltage)				% Nominal (Nom.) Line Voltage x10 (Elapsed time display)
95V Nom.	115V Nom.	220V Nom.	230/240V Nom.	
86	104	199	217	900±20
87	105	201	219	910±20
88	106	203	221	920±20
89	107	205	224	930±20
90	109	207	226	940±20
91	110	210	229	950±20
92	111	212	231	960±20
93	112	214	233	970±20
94	113	216	236	980±20
95	115	220	240	1000±20
96	117	223	243	1010±20
97	118	225	245	1020±20
98	119	227	248	1030±20
99	120	229	250	1040±20
100	121	232	253	1050±20
101	122	234	255	1060±20
102	124	236	257	1070±20
103	125	238	260	1080±20
104	126	240	262	1090±20
105	127	243	265	1100±20

6. Depress the Start/Hold switch for five seconds.

7. Verify that the value in the elapsed time display equals the percent of nominal voltage read from the table in step 5.

8. If the displayed values are within tolerances, continue with Section 4.5, Oxygen/Air Regulator Checks and Adjustments. Otherwise, continue with the adjustment procedure below.

Adjustment Procedure

1. Switch the power switch Off.

2. Depress and hold down the Reset switch while you switch the power switch On to enter the % Line Voltage Calibration routine.

3. Slowly adjust R3 on power supply board as required until the elapsed time display equals the value read from the table in step 5 of the test procedure.

4. Continue with Section 4.5, Oxygen/Air Regulator Checks and Adjustments.

4.4 Controller Calibration (Prior to Software Revision 04.01)

This section has been included to facilitate service of IWS product with controller board with a Software Revision prior to 4.01. Refer to Section 8 for a detailed circuit diagram.

This controller board is identified by the presence of a four position dip switch; controller boards with software revision 4.01 or higher have an eight position dip switch. This board is no longer available. If this board fails the calibration and adjustment section, the board should be replaced. When replacing this board order controller service kit:

6600-0360-800	EMI Noise Suppression Kit for English IWS Models
6660-0360-801	EMI Noise Suppression Kit for French IWS Models
6600-0360-802	EMI Noise Suppression Kit for Spanish IWS Models
6600-0360-803	EMI Noise Suppression Kit for German IWS Models
6600-0360-804	EMI Noise Suppression Kit for Spanish IWS 2001 Models
6600-0360-805	EMI Noise Suppression Kit for French IWS 2001 Models
6600-0360-806	EMI Noise Suppression Kit for English IWS 2001 Models

Each controller service kit includes EMI shielding to minimize susceptibility of the replacement controller board to electrostatic discharge, power line conducted noise and radiated electromagnetic interference. See Section 7 for a list of the kits contents.

The earlier version controller board contains a four position dip switch. The setting of each switch position may change (On or Off) during the calibration procedure, depending on the adjustment procedure being performed.

	Dipswitch Position			
	1	2	3	4
PTG Alarm 1.0 degree	0	0	0	0
PTG Alarm 0.5 degree	1	1	0	0
Cal Display Loop	0	0	1	0
Cal ADC Loop	0	0	0	1
Triac Test Loop	0	1	1	1
Service Loop	1	1	1	1
	0 = Off		1 =On	

4.4.1 Power Supply Board Voltages

1. Configure the four position test switch (S1) located on the control board as follows:

   Switch #1,#2, #4 Open (Off)

   Switch #3 Closed (On)

2. Connect the controller assembly to an appropriately rated power source (listed voltage ± 10%), and switch the power switch On.

   Note: You will go through the normal start up routine. Patient temperature alarms may trigger.

3. Check that all display segments are On, the observation lamp is On, the alarm light is On, the heater radiates heat, and a continuous alarm tone sounds.

4. Check that the following dc voltages are present at the test connector (T1) located on the control board. Voltages should be within the tolerances specified; otherwise follow the recommended corrective action:

Test Point	Reading	Corrective action
TP7 Ground (common)	—	—
TP3 (9.0 Vdc ST.)	9 ± 0.2 Vdc	adjust R4 on Power Supply PCB
TP4 (5.0 Vdc LEDS)	5 ± 0.3 Vdc	replace Power Supply PCB
TP5 (5.0 Vdc ST.)	5 ± 0.3 Vdc	replace Power Supply PCB

4.4.2 Display Brightness Check

Note: The display brightness is pre-calibrated at the factory and should only require adjustment if replacing a component on the display board.

Test Procedure

1. Configure the four position test switch (S1) on the control board as follows:

   Switch #1, #2, #4 Open (Off)

   Switch #3 Closed (On)

   Connect the controller assembly to an appropriately rated power source and switch the power switch On.

2. Check that all the displays are illuminated and are of uniform brightness.

   Note: IWS 2001 International units do not have a control temperature display.

3. If the displays are acceptable proceed to Section 4.4.3, Alarm Volume, at step 2. If the displays are not adequately illuminated, proceed with the adjustment procedure.

Adjustment Procedure

CAUTION

⚠ The back panel and display panel may drop down when the bottom cover mounting screws are removed. Be sure to secure the panels with tape before disassembly.

1. Switch the power switch Off and unplug the unit.
2. Tape the display panel and back panel to the top cover.
3. Remove the four outside corner mounting screws from the bottom of the display panel. Do not remove the two inside mounting screws. Remove the bottom display cover by sliding it down.
4. Connect a digital voltmeter across R10, located on the bottom edge of the display board.
5. Connect the controller assembly to an appropriately rated power source.
6. Turn On the power switch leaving the test switch S1 settings unchanged from step 1 of the Test Procedure Section above.
7. Adjust R9 on the display board until the voltage across R10 is 3.30 ± 0.2 Vdc.
8. Verify that all segments of all displays are illuminated and are of uniform brightness.
9. Switch the power Off.
10. Replace the bottom of the display panel using the four screws previously removed.

4.4.3 Alarm Volume

WARNING ⚠ **Lowering the volume excessively may prevent caregivers from hearing alarms. The alarm volume and frequency are precalibrated at the factory for both replacement boards and controllers. Volume adjustments should not normally be required in the field.**

Test Procedure

1. All four positions on test switch (S1) on the controller board should be Off. Switch the power switch On.
2. Activate the alarm by selecting the servo mode and unplugging the patient probe, or alternatively, hold down the Alarm Silence switch for five seconds (IWS 2001 International models). You should hear an alternating two tone alarm.
3. Ensure the alarm tone and volume are at the desired levels. Verify that the audio alarm level is adequate in a location with a background noise level of 55 dBA max. If the audio alarm level is acceptable, continue with Section 4.4.4, Analog to Digital Converter Calibration. If the audio alarm level is unacceptable, continue with the adjustment procedure.

Adjustment Procedure

1. Switch the power switch Off.
2. Positions #1, #2 and #4 on test switch (S1) on the controller board should be Off. Position #3 should be On. Switch the power switch On.
3. Verify that the frequency at pin 1 of the control board test connector is 2.050 kHz ± 0.1 kHz. Adjust R38 on the control board as required.
4. Continue with Section 4.4.4, Analog to Digital Converter Calibration, at step 4.

4.4.4 Analog to Digital Converter (ADC) Calibration

1. Switch the power switch Off.
2. Configure the four position test switch (S1) on the control board as follows:

   Switch #1, #2, #3 Open (Off)

   Switch #4 Closed (On)

3. Connect the controller assembly to an appropriately rated power source and switch the power switch On and allow the unit to stabilize for 5 minutes.
4. Connect a resistance of 5900 ± 0.1% to the patient probe connector.

   Note: 5900 ± 0.1% is switch setting I7 on the temperature simulator box.

5. Verify that the ADC counts displayed on the elapsed time display is 1122 ± 2 counts. Slowly adjust R44 on control board as required.

6. Connect the following resistances to the patient probe connector and verify the correct temperature readings appear in the patient temperature display.

Resistance	Switch Setting	Patient Temperature Display
5496 ± 0.1%	(I2)	39.0 ± 0.1 degrees
7060 ± 0.1%	(I3)	33.0 ± 0.1 degrees
5900 ± 0.1%	(I7)	37.3 ± 0.1 degrees
6190 ± 0.1%	(I11)	36.2 ± 0.1 degrees

Note: The resistance values shown above are available on the Temperature Simulator. The switch positions are listed in parentheses.

7. If the displayed values are within tolerances, continue with Section 4.4.5, Line Voltage Compensation. If not, replace the control board.

4.4.5 Line Voltage Compensation

WARNING ⚠ ***Use extreme care while performing calibration and adjustment procedures, or while working on the Infant Warmer System with power connected. An electrical shock hazard does exist; be certain to observe all safety precautions.***

Test Procedure

1. Set the four dipswitches on the control board to OFF.
2. Switch the power switch On.
3. Press ▼ and turn off heat.
4. Press and hold the hidden switch on the control panel located directly above the alarm silence switch.
5. After two seconds the display should indicate as follows:
   a. Patient Temperature displays 25.0 ± 0.1°
   b. Control Temperature displays 37.9 ± 0.1°
   c. Elapsed Time displays % nominal line voltage ± 2%
6. Switch the power switch Off and unplug the power cord from the wall outlet.
7. Use a digital volt meter and measure the line voltage at the wall outlet.
8. Connect the controller assembly to an appropriately rated power source and turn the power switch On.
9. Read the corresponding percent of your unit's nominal voltage from the following table. The outlet voltage selects the row and the unit's nominal voltage selects the column. For example, if the line voltage measures 110 Vac for a 115 Vac nominal unit, the % nominal voltage is 95% and 95 ± 2 should appear in the control temp display in step 8.

   Note: Record this value from the table for later use.

Line (Outlet Voltage)				% Nominal (Nom.) Line Voltage x10
95V Nom.	115V Nom.	220V Nom.	240V Nom.	(Elapsed time display)
86	104	199	217	90±2
87	105	201	219	91±2
88	106	203	221	92±2
89	107	205	224	93±2
90	109	207	226	94±2
91	110	210	229	95±2
92	111	212	231	96±2
93	112	214	233	97±2
94	113	216	236	98±2
95	115	220	240	100±2
96	117	223	243	101±2
97	118	225	245	102±2
98	119	227	248	103±2
99	120	229	250	104±2
100	121	232	253	105±2
101	122	234	255	106±2
102	124	236	257	107±2
103	125	238	260	108±2
104	126	240	262	109±2
105	127	243	265	110±2

10. Verify that the value in the elapsed time display equals the percent of nominal voltage read from the table in step 7.

11. If the displayed values are within tolerances, continue with Section 4.4.6, Safety Circuit Test. Otherwise, continue with the adjustment procedure.

Adjustment Procedure

1. Slowly adjust R3 on power supply board as required until the elapsed time display equals the value read from the table.

2. Continue with Section 4.4.6, Safety Circuit Test.

4.4.6 Safety Circuit Test (Prior to Software Revision 03.11)

1. Configure the four position test switch (S1) located on the control board as follows:

Switch #1	Open (Off)
Switch #2, #3, #4	Closed (On)

2. Switch the power switch On.

3. The front panel should display the following:

   Pat. Temp. EEE
   Cont. Temp. EEE

   Elapsed Time Running in Stop Watch Mode

4. Confirm that the heat indicator LED on the control board is illuminated.

5. Use a stop watch and verify that elapsed time display is accurate within ± 1 second per minute.

6. After approximately 3 minutes and 20 seconds (for 60 Hz models) or approximately 4 minutes (50 Hz models) a two tone alarm occurs which cannot be silenced.

7. Confirm the heat indicator LED on the control circuit board (viewed from the rear of unit) is Off.

8. Switch the power switch Off and restore the test switch to the original configuration (all switches Open).

4.4.7 Triac Safety Circuit Test (Rev 03.11 Software Only)

1. Place the individual test switches in the following positions:

   Switch #i Open ("Off")

   Switch #2,#3, #4 Closed ("On")

2. Switch the power switch on.

3. The front panel should display the following:

   Pat Temp EEE
   Cont Temp EEE
   Elapsed Time Running in stop watch mode.

4. Let run until the display indicates 03:10 (3 minutes 10 seconds) for 60 hertz units or 03:50 (3 minutes 50 seconds) for 50 hertz units.

   Note: The elapsed timer may reset back to 00:00 and restart timing and the audio alarm activate for 1 second before the time elapses. If so wait until the timer gets back to 03:10 or 03:50.

5. Confirm that the heat indicator LED on the control board is lit.

6. Let the unit run until a warbling two tone alarm which cannot be silenced occurs (5 minutes maximum time).

7. Confirm the elapsed timer stops between 03:10 and 03:40 for 60 hertz units (03:50 and 04:20 for 50 hertz units).

8. Confirm that the heat indicator on the control board is off.

9. Switch the power switch Off and restore the test switch to the original configuration (all switches Open).

4.4.8 Test Loop

Complete Unit Testing

1. Switch the power Off.
2. Configure the four position test switch S1 on the control board in the test loop position. All switches Closed (On).
3. Switch the power switch On.

4. Verify that the following sequence occurs:

   a. For the first second:

      All segments, LEDS, and high-low alternating tone audible alarm are On.

   b. For the next second:

      High-low alternating tone audible alarm On. Patient display "60H" for 60 Hz ("50H" for 50 Hz).

      Elapsed time display - software revision number.

   c. The unit should then loop in the following order until the power is removed:

Seven Seg Display's	Bar Graph Segments	Alarm LEDs	Mode LEDs	Heater and Lights
All 1's	1,11	*Probe fail	*Servo	On
All 2's	2,12	Pat. temp.	*Servo	Off
All 3's	3,13	Sys. fail	*Servo	On
All 4's	4,14	Heater Off	Manual	Off
All 5's	5,15	Reset timer	Manual	On
All 6's	6,16	Spare LED	Manual	Off
All 7's	7,17	All Off	Apgar	On
All 8's	8,18	All Off	Apgar	Off
All 9's	9,19	All Off	Apgar	On
All 0's	10,20	All Off	All Off	Off
All Off	All Off	All Off	All Off	Off

* LED indicators not present on IWS 2001 International units.

While looping through this test loop the program also does RAM tests, memory checksum, and ADC calibration tests. If any error occurs, an error number will be displayed in the Elapsed Time display and the critical alarm will sound for 2 seconds. The program will then continue to loop and display any additional error numbers. See Section 6 for error code descriptions.

5. Switch the power switch Off and restore the test switch to the original configuration (or all switches Open).

   For patient temperature alarm-difference setting greater than 0.5 degree C:

   Switch #1, #2 should be closed (On)

   Switch #3, #4 should be open (Off).

6. Replace the back panel.

Controller Unit Testing Separate From Warmer

Note: If required, the controller unit can be tested separately from the warmer. The following test load may be connected in place of a heater assembly.

1. With the power switch Off connect the controller assembly to a test load as follows:
2. Between J17 pin 3 (phase) and J17 pin 1 (heater N) connect a 400 watt resistive load for 115 Vac.
3. Between J17 pin 3 and J17 pin 2 (alarm light N) connect a 12 watt resistive load for 115 Vac.
4. Between pin 1 and pin 3 of the observation light connector, place a 50 watt resistive load for 12 Vac.

4.5 Gas Regulator Check

1. Turn supplies, disconnect the gas pipeline connection, and attach a cylinder to each manifold.
2. Connect the regulator setting tool (.025 in. orifice open) to the power outlet, open cylinder slowly and check for the correct regulator setting per table below. Adjust the regulator as necessary.

Cylinder	Outlet Pressure
2000 psig (36 bar)	*49.5 ±2 psig (3.37 ± .14 bar) (with .025" orifice bleed)*
1500 psig (102 bar)	52.0 ±2 psig (3.54 ± .14 bar) (with .025" orifice bleed)
1000 psig (68 bar)	54.0 ±2 psig (3.67 ± .14 bar) (with .025" orifice bleed)
750 psig (51 bar)	55.0 ±2 psig (3.74 ± .14 bar) (with .025" orifice bleed)

3. Check the system for leaks according to procedure in section 5.8.G.

4.6 Electrical Safety Check

A. Leakage Current

Use approved equipment and techniques to test the unit's leakage current and ground continuity. Follow the directions supplied by the test equipment manufacturer to verify the following:

1. Less than 100 microamperes measured at any exposed metal surface for equipment rated at 120 Vac, 50/60 Hz.

2. Less than 200 microamperes measured at any exposed metal surface for equipment rated at 220 Vac, 50/60 Hz, 230 Vac, 50/60 Hz or 240 Vac, 50/60 Hz.

3. On elevating models, repeat the leakage current test while raising and lowering the bed to ensure that the leakage current remains within limits

B. Ground Resistance Check

Use a low range ohmmeter or electrical safety analyzer to measure the resistance between the ground pin on the line cord plug and exposed metal of the warmer. The ground resistance must be less than 0.2 ohms.

Note: Higher readings may indicate loose or oxidized connections in the power cord or grounding circuits.

4.7 Bed Motor Raise and Lower Test (Elevating Models Only)

1. Press the Raise Bed switch.
   a. Ensure that the bed elevates smoothly.
   b. Ensure that the motor continues operating with a over riding clutch action at the upper limit (~46-1/2 inches, or 118 cm, from the top of the mattress to the floor).

2. Press the Lower Bed switch.
   a. Ensure that the bed lowers smoothly.
   b. Ensure that the motor continues operating with a over riding clutch action at the lower limit (~38-1/2 inches, or 98 cm, from the top of the mattress to the floor).
   c. Verify operation of bed foot switches (if present).

CAUTION ⚠ On elevating models, do not continue to run the motor at upper and lower limit positions; equipment damage may result.

WARNINGS

⚠ **Before any disassembly or repair, disconnect the electrical power and the gas line supplies. Remove any gas cylinders.**

⚠ **After completing a repair, the appropriate calibration procedure must be performed. After completing any portion of the calibration and adjustments procedures, perform the Checkout Procedure to make sure the Infant Warmer System is in proper operating condition. In addition, a final electrical safety check and leakage current test must be performed. If the unit fails any steps of the Checkout Procedure it must be removed from service and repaired. Record the information for future reference.**

Use the Static Control Work Station to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

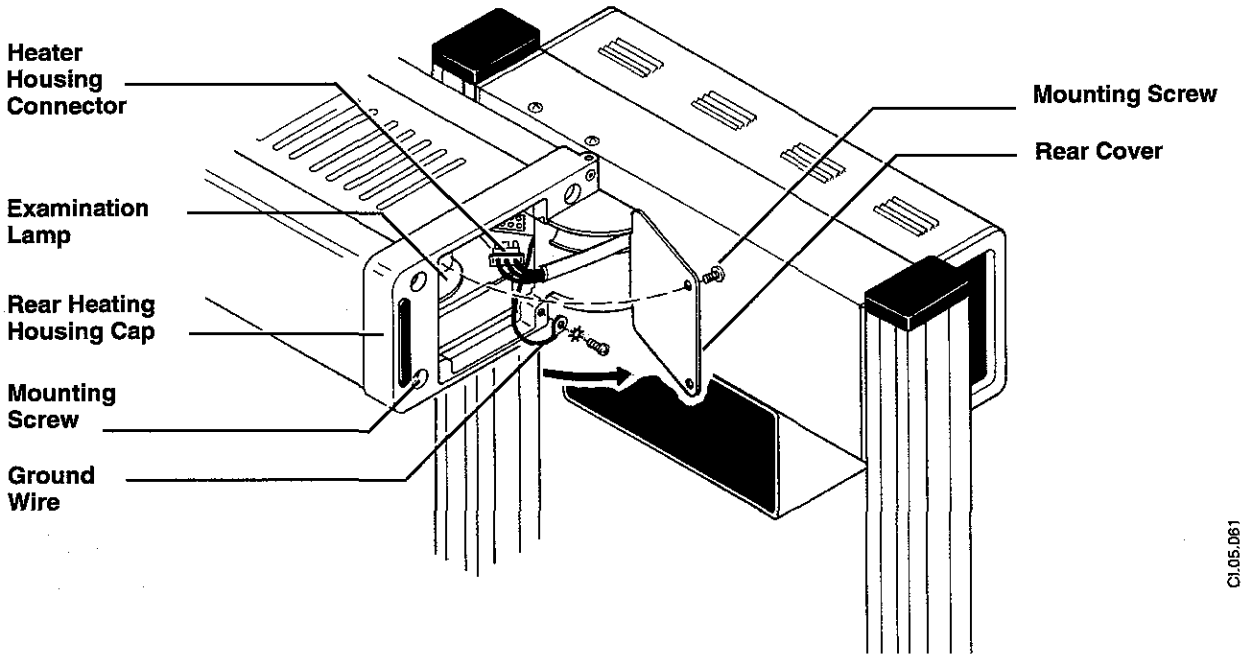


Figure 5-1
Removal of Back Cover from Heater Assembly

5.1 Heater Module Repairs

A. Heater Housing Disassembly

(See Figures 5-1 and 5-2)

1. Disconnect the Infant Warmer System Power Cord.
2. Rotate the heater to the X-ray position.

3. Remove the two Phillips head mounting screws for the back cover, and remove the cover (some older units have three screws securing the cover).

4. Disconnect the heater housing connector. Squeeze the locking tabs on the rear of the plug to disengage the lock mechanism.

5. Remove the ground wire for the heater housing.

For with HAK, AAN, HAJ and HCA serial numbers

6a. Remove the four mounting screws for the front cover plate and remove the plate.

b. Remove the four mounting screws for the front heater housing cap and remove the cap.

For units with the HCC serial number

6a. Remove the screw and lockwasher from the top of the cushioned heater head, then remove the screw and alarm light lens from the bottom of the heater head. Now the heater head can be pulled off the front of the unit.

b. Remove the four screws from the end cap support plate and remove the plate.

7. Push the heater assembly out the front of the heater housing. Avoid bending the rear of the heater assembly.

8. To make disassembly easier, the four mounting screws for the rear heater housing cap may be loosened. Do not entirely remove the mounting screws.

Note: The heater, alarm lamp sockets, examination light socket, and wiring harness can be replaced when the heater assembly is removed.